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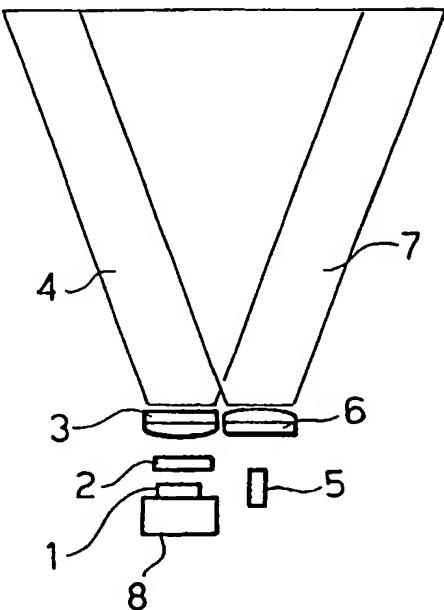
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
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[Continued on next page]

(54) Title: AN ACTIVE ELECTRO-OPTICAL DEVICE FOR DETECTING OBSTACLES, IN PARTICULAR FOR AUTONOMOUS NAVIGATION



(57) Abstract: An electro-optical system capable of being embarked aboard mobile ground or flying units, to determine the optical flow generated by obstacles in relative motion with respect to the mobile unit. The system comprises radiation (5), receiver means (1) for converting the radiation reflected by the objects into electrical signals and means (8) for processing the signals generated by the receiver means. The receiver means (1) are based on vision sensors with matrix configuration. The emitter means (5, 6) shape the radiation beam in such a way that the radiation reflected by the objects and collected by the receiver means impacts at least on a part of the receiver matrix. The processing means compute the optical flow only on the elements of the receiver matrix that are impacted by the radiation.

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TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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INTERNATIONAL SEARCH REPORT

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PCT/EP2004/000601

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 G01S17/89 G01C11/02 G06T7/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01S G01C G06T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PARK S-B ET AL: "A motion detection system based on a CMOS photo sensor array" IMAGE PROCESSING, 1998. ICIP 98. PROCEEDINGS. 1998 INTERNATIONAL CONFERENCE ON CHICAGO, IL, USA 4-7 OCT. 1998, LOS ALAMITOS, CA, USA, IEEE COMPUT. SOC, US, 4 October 1998 (1998-10-04), pages 967-971, XP010586845 ISBN: 0-8186-8821-1	1-6, 21-25
Y	----- -/-	8-14

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

8 July 2004

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB2004/000601

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CHIH-HO YU ET AL: "Determination of horizontal motion through optical flow computations" OCEANS '93. ENGINEERING IN HARMONY WITH OCEAN. PROCEEDINGS VICTORIA, BC, CANADA 18-21 OCT. 1993, NEW YORK, NY, USA, IEEE, 18 October 1993 (1993-10-18), pages II475-II480, XP010117554 ISBN: 0-7803-1385-2	1-6, 21-25
Y	-----	8-14
Y	WO 01/96147 A (AUTOMOTIVE SYSTEMS LAB) 20 December 2001 (2001-12-20) figures 4,5 -----	8-14
X	EP 1 256 816 A (ARETE ASSOCIATES INC) 13 November 2002 (2002-11-13) abstract paragraphs [0034], [0036], [0049], [0118] figure 2 -----	1-5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2004/000601

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-14, 21-25

Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-14,21-25

active optical flow system with shaped beam

2. claims: 15-20

active optical flow system with plurality of sources

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US2004/000601

Patent document cited in search report	Publication date		Patent family member(s)		Publication date
WO 0196147	A 20-12-2001	EP JP WO US	1297486 A2 2004503759 T 0196147 A2 2002050924 A1		02-04-2003 05-02-2004 20-12-2001 02-05-2002
EP 1256816	A 13-11-2002	WO EP AU AU AU AU CA DE EP US	9718487 A1 1256816 A2 721425 B2 5414296 A 762076 B2 6410100 A 2237894 A1 69529851 D1 0861445 A1 5467122 A		22-05-1997 13-11-2002 06-07-2000 05-06-1997 19-06-2003 14-12-2000 22-05-1997 10-04-2003 02-09-1998 14-11-1995

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